A Threat to Teen Workers

Disinfectants and Occupational Illness

Three out of four U.S. adolescents work at some time during their junior and senior years of high school. Youth workplace injury and illness may be underreported because the majority of teen employees work part-time, even during the summer; children may not enter the workers' compensation system and therefore may be missed by ongoing surveillance. Are important trends being missed? This month, Theresa A. Brevard of The Ohio State University and colleagues report on the first study to measure the magnitude, incidence, and nature of disinfectant-related occupational illness in young workers, and they find room for improvement [***EHP* 111:1654–1659**].

In 1996–1998, according to the Bureau of Labor Statistics, 24.8% of youth aged 15–17 worked during the school year, with that figure swelling to 34.2% during the summer. In the food and beverage industry, the most common workplace for minors, disinfectants are used to keep preparation surfaces and equipment clean and germ-free. Disinfectant exposure can happen in other industries, as well, including recreation-related jobs such as lifeguarding (where workers may be responsible for chlorinating the pool) and cleaning, manufacturing, and service jobs.

Brevard and colleagues looked at data on disinfectant-related illnesses for 1993–1998 from two sources: the Toxic Exposure Surveillance System, maintained by a nationwide network of poison control centers, and the California Department of Pesticide Regulation, which keeps detailed data on known and suspected acute poisoning cases, including those involving disinfectants. The team examined data for teen workers under age 17 and, as a comparison group, adult workers aged 25–44.

Super-sized exposure? A study showed that teens were more than four times as likely as adults to be injured or made ill by workplace exposure to disinfectants such as those used in the food and beverage industry.

The researchers tracked episodes of worker illness and injury related to five classes of disinfectants: halogens including hypochlorites (bleach and its relatives), quaternary ammonium compounds (hard-surface cleaners that impede bacterial growth at high dilution), phenolic agents (including coal tar disinfectants such as Lysol), products containing pine oils (added more for their "clean" scent than their cleansing properties), and "unspecified" agents (where the identity of the specific disinfectant was not determined).

The researchers found that adolescents, with 307 episodes of illness, were more than four times as likely as adults to be injured or made ill by workplace exposure to disinfectants. The most commonly reported illnesses and injuries (59%) came from exposure to halogens, and the skin and eyes were the most commonly affected organs. Although overall risk was higher for adolescents than for adults, adults working in the industries that employ the most young workers also had more disinfectant-related illness than all other working adults.

Most of the reported effects, such as scratchy throat and watery eyes, were characterized as mild, causing minimally bothersome, rapidly resolved health issues. Less frequent but more serious effects included corneal abrasions and second- and third-degree skin burns. None of the cases examined involved severe injuries or fatalities. In cases where data on personal protective equipment use were available, 65% of illness and injury fell to teens who were not using safeguards.

The authors raise the need for better enforcement of existing health and safety regulations, especially those related to the appropriate use of personal protective equipment, and suggest revision of the Fair Labor Standards Act to include disinfectants as a hazard against which young workers must be protected. They call for states to do a better job of collecting information on disinfectant-related illness and to establish uniform reporting requirements, which would make it easier to establish how these injuries are impacting the work force. **–Victoria McGovern**

Pesticides in Pregnant Women

Some Cumulative Exposures Exceed Safe Levels

Following passage of the 1996 Food Quality Protection Act, the U.S. Environmental Protection Agency (EPA) created new guidelines for assessing risks associated with pesticide exposure. In contrast to earlier risk assessment methodologies, the new guidelines provide a framework for estimating the cumulative risk from multiple pesticides sharing a common mechanism of toxicity. This month, Rosemary Castorina of the Center for Children's Environmental Health Research at the University of California, Berkeley, and colleagues report on one of the first case studies using the new guidelines [***EHP* 111:1640–1648**]. Their results indicate that approximately 15% of the pregnant women they studied may have experienced cumulative organophosphate (OP) pesticide exposures exceeding a health-protective value.

OP pesticides are commonly used against insects in home and agricultural environments, and exposure is widespread. Abundant data indicate that low-level exposure to OP pesticides, prenatally and postnatally, affects the growth and neurodevelopment of young animals. These chemicals' mechanism of toxicity is inhibition of cholinesterase, an enzyme that helps control nerve transmission.

In its revised guidelines, the EPA has determined the quantity of each of 33 OP pesticides that reduces brain cholinesterase activity in test animals by 10%—the so-called oral benchmark dose$_{10}$ (BMD$_{10}$). The BMD$_{10}$ can be used to calculate a relative potency factor to weigh the toxicities of different related pesticides in terms of a single "index pesticide."

Castorina and colleagues drew their study population from participants in the Center for the Health Assessment of Mothers and Children of Salinas study, a longitudinal birth cohort study designed

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in part to investigate pesticide exposures and their effects in pregnant women and children. Urine samples were collected twice during pregnancy and once after delivery, and were analyzed for 6 OP metabolites. Complete data were available for 446 women. The team also obtained reported pesticide use data for the corresponding time period from the California Department of Pesticide Regulation.

The researchers used two methods to calculate pesticide dose based on urinary metabolites. In the first, they assumed that all relevant metabolites in a sample derived from exposure to a single pesticide. This method yielded an upper limit for exposure to each of 8 pesticides representing many that are used heavily in the Salinas Valley, an area of intensive year-round agricultural production. In the second method, the metabolites were assumed to result from exposure to multiple pesticides. A likely mixture was calculated based on reported chemical use in the Salinas Valley, and a relative potency factor for each constituent pesticide was calculated using chlorpyrifos as the index chemical.

For this study, the team calculated a health-protective pesticide reference dose by dividing each pesticide's oral BMD_{10} by 100. Doses higher than this were deemed to be of concern.

The results using the first method suggested that between 0% and 36% of the study population may have exceeded safe levels of exposure, depending on the pesticide analyzed. The results using the second method indicated that 14.8% of the women had excessive exposure, but due to uncertainty about the actual mixture, the range spanned from 1% to 34%.

The researchers note that each method introduces its own uncertainty. However, they believe that they have proposed a reasonable approximation of exposures, and future studies will incorporate chemical-specific biomonitoring data to counter some of this uncertainty. These preliminary results indicate a need for further research, especially as the fetal dose from maternal exposure is unknown. **–Julia R. Barrett**

Livestock Drugs Infiltrate Dust

Another Hazard for Farmers

Recent research has investigated how human and veterinary drugs enter the environment at subtherapeutic concentrations and what the downstream effects of this contamination may be. Now German researchers led by Gerd Hamscher of the Hannover School of Veterinary Medicine have documented a new route of entry for veterinary drugs into the environment, and they cite a new potential risk for people who spend long periods inside enclosed animal buildings: inhaling residues of antibiotics in the dust in such buildings [***EHP* 111:1590–1594**].

Antibiotics are given to livestock to preempt disease, treat outbreaks of illness, control the spread of infection from sick to healthy animals, and promote growth. Large-scale use of antibiotics in pig production is widespread within the European Union and the United States, although its use in the European Union is now restricted to treating and containing infection.

The researchers used tandem mass spectrometry to retrospectively analyze dust samples taken from a 350- to 420-head pig-fattening farm from 1981 to 2000. Dust was collected using a metal sampling frame placed 1.5 meters above the floor, the typical breathing height of humans. From the 10–15 samples collected inside the building each year, the researchers randomly selected 1 for analysis. The dust particles originated primarily from the animals' feed and dried feces and urine.

In 18 of the 20 samples analyzed, as many as 5 different antibiotics were detected at levels of 0.2–12.5 milligrams per kilogram (mg/kg) dust. Tylosin occurred in 16 samples, reaching a top concentration of 12.18 mg/kg. Sulfamethazine was present in 13 samples at levels up to 2.9 mg/kg. Several tetracyclines appeared in 12 samples at concentrations of 0.2–5.2 mg/kg. Both tylosin and sulfamethazine can cause allergic reactions in susceptible people, and the European Union banned tylosin as a feed additive in 1998. Chloramphenicol was detected in 3 samples at concentrations of 2.0–9.1 mg/kg. Chloramphenicol is capable of causing severe side effects in humans, including in rare cases aplastic anemia and gray baby syndrome (another name for chloramphenicol toxicity in newborns, the often-fatal result of giving newborns the drug for bacterial infection). The compound was prohibited in farming in 1994, Hamscher says, because of its potential to damage DNA. Neither tylosin nor chloramphenicol were found in samples taken after their respective bans.

Pharmaceuticals have been detected in rivers and groundwater at parts-per-billion levels ranging up to several micrograms per liter. In contrast, says Hamscher, these dust samples yielded relatively high drug content for an environmental sample—in the parts-per-million range, representing concentrations approximately three orders of magnitude higher.

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Snout route. Research shows that veterinary pharmaceuticals can enter the environment through barn dust, putting livestock farmers at risk for inadvertently inhaling these drugs.

Other studies have shown that chronic exposure to subtherapeutic concentrations of antibiotics is optimal for the development of resistance. Furthermore, the same allergenicity risks posed by consumption or injection of antibiotics may also occur through inhalation. No acceptable daily intake has been established for drugs inhaled via dust.

Because of the potentially harmful effects of inhaling antibiotic-laden dust, the study authors conclude that the use of antibiotics in farm animals should be reduced when possible. They also say further investigation with more frequent sampling rates is needed of the dust in larger pig operations (this facility was relatively small) as well as hen houses, where the potential for dust production is even higher than in pig houses. Future research on the risks to farmers of breathing dust laden with microorganisms and allergens should also examine antibiotic residues and their impact. Such investigations should include monitoring farmers' health and determining their state of antibiotic resistance. **–Carla Burgess**